

Intro:

Ensure you know your vehicle, and check it daily:

Knowing how the 4x4 system works on your vehicle is essential. Being able to ensure the best grip in testing conditions can make the difference between a safe journey and a failed journey.

Drivers should always work within the manufacturer's recommended limits, unless their risk assessment and safe working practice clearly recommends otherwise. Going beyond these limits may be dangerous.

Manufacturers specify limits for a reason – these are usually to do with the safety and continued function of the vehicle, or of vehicle components. Exceeding manufacturers limits will usually void warranties and will often lead to costly repairs and lost time. Failure or compromise of vehicle components may lead to severe loss of control, and in the event of an incident the driver and their organisation may be held liable.

Always have access to the vehicle manual

We can't all remember everything about our vehicles, but being able to find details like tyre pressures, jump lead connection points, and the technicalities of the 4wd system is a must. Any modifications or attachments must also have manuals with them.

Vehicle manuals will also provide the information required to carry out pre-use checks, which are the responsibility of the driver.

In combination with the vehicle checks, the handbook will help to familiarise the driver with the use and effect of the different controls fitted to the vehicle.

- *Manuals often include optional equipment which may not be fitted on your vehicle – understanding the fitted equipment and controls on your vehicle is essential for safe use – take some time to ensure you understand all of the safety features of your vehicle as well as any additional aids it may be fitted with, along with any modifications and attachments.*

This is a requirement under the Provision and Use of Work Equipment Regulations (PUWER 1998 – [Brief Guide to PUWER](#))

1:

Check your vehicle on a daily basis

1:1

Tyres:

Understand tyre types

Tyres are the part of the vehicle that is responsible for getting the vehicle moving, steering it safely, braking and stopping the vehicle. Understanding the tyres is essential, as you'll be asking them to do all of your work for you! Different tyres perform better under different circumstances, from high performance road tyres, through winter tyres to deep lugged off-road tyres. Know the benefits of each, but be especially aware of their limitations.

- *Tyre types should be consistent, mixing tyre types will lead to handling issues.*

Look at markings and tread patterns:

M+S denotes that the tyre manufacturer has designed them to work better in soft, deformable ground. This is not specifically a winter tyre, but the marking may also be found on winter tyres for off-road 4x4 use. M+S tyres do not need to go through any specific testing process before a manufacturer puts this marking on a tyre. In some European countries, this marking fulfils the winter tyre requirement, though other countries require a 3pmsf marked tyre (see below).

- *M+S tyres may have lower grip levels on hard, non-deformable surfaces.*





The alpine three peaked mountain snowflake symbol (**3pmsf**) tyre marking denotes that the tyre has met a minimum threshold for grip under braking on snow. Both road and off-road biased tyres can be marked with the 3pmsf marking.

- *3pmsf tyres may have lower grip levels in high temperatures and should be checked for degradation regularly.*



Winter tyres in general will be made of a slightly softer compound rubber, allowing tyres to mould to the road even at sub-zero temperatures. The recognised point at which winter tyre compounds begin to beat summer compounds is 7Celsius, though some 'All-Season' tyres operate through this temperature range.

Winter tyres will also often have increased 'siping' on the tyre, often seen as zig-zag lines dividing up larger tread blocks.

- *Sipes can degrade in higher temperatures. Heavily siped tyres should be changed prior to summer use above 20Celsius.*



HT tyres (Highway Terrain) have a variety of tread patterns, but the gaps between tread blocks will be small, to ensure the maximum amount of grip from rubber on the road is ensured. Angled channels allow water to be displaced away from the tyre to reduce aquaplaning. Severe wet weather tyres have large curved channels designed to shift large amounts of water, though there is always a point at which any tyre can no longer move the water out of the way and will begin to float.

- *HT tyres may only provide limited grip off-road and on deformable surfaces.*



AT tyres (All Terrain) tyres also come in a variety of tread patterns, but will tend to have slightly larger gaps between tread blocks (around the size of your little finger) to enable them to sink into deformable surfaces for grip. Curved channels allow for water displacement on-road, and horizontal channels across the tyre are designed for grip on turf and looser surfaces.

- *AT tyres may provide less grip than HT winter tyres in winter conditions on tarmac.*



MT tyres (Mud Terrain) are designed for deformable surfaces, where grip may be found by digging down. Large gaps exist between tread blocks (around the size of your thumb). They are often made of a harder rubber compound, to resist the damage caused by wheelspin. These tyres are only really suitable for extensive off-road use.

- *MT tyres may provide less grip on hard surfaces such as tarmac or frozen ground. The harder compound and reduced contact area can lead to extended braking and reduced cornering in winter conditions on-road.*

1:2

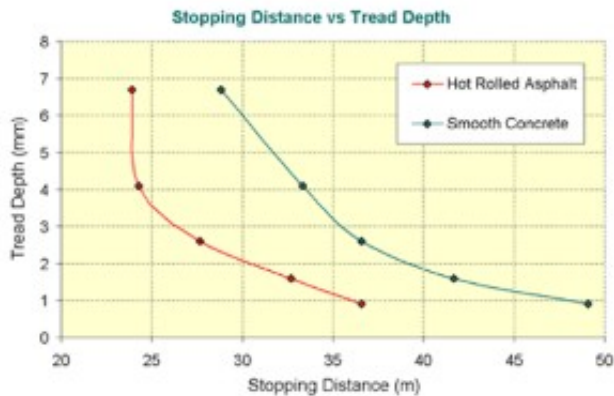
Check tyre pressures, tread depths and condition (inc. wheels)

Tyre pressures should match the vehicle manufacturer's specifications, unless specific written provision is in place to match a specialist tyre type.

- *Uneven tyre pressures, especially across axles may lead to severe grip problems, both under braking and acceleration, and will lead to handling problems on all surfaces.*
- *Reducing tyre pressures is a final option if looking to gain grip when a vehicle is immobilised. Pressures should never be reduced below 16psi. If reduced, speeds must be reduced accordingly. At 16 psi a maximum of 5mph is advised. Normal road speeds should not be attempted unless tyres are within the manufacturer's specifications.*
- *Do not attempt to reduce tyre pressures unless you have a pressure gauge to check levels and access to a pump to inflate them again before returning to the road.*

The legal minimum tread depth of 1.6mm (across the central $\frac{3}{4}$ of the tyre, and around

the entire circumference) is required at all times. For winter, off-road and adverse weather use, tyres should be replaced at 3mm to ensure grip and water dispersal properties are suitable for the tasks undertaken. A 3mm tread depth is recommended by RoSPA for all vehicles due to the increase in braking distances as tyres wear down:



In 2003, the British Rubber Manufacturers Association (BRMA) commissioned MIRA to study the effect of tyre tread depth on braking distances. Using tyres of varying tread depths, they performed repeated stops on two different wet surfaces at 80 kph (50mph). Braking distances are evident throughout, with significant increase below 3mm.

(Source: RoSPA.)

- Tyre condition should be checked daily to ensure that there are no cuts or bulges in the tyre and where possible, stones should be removed.
- Tyre repairs should be avoided, but where necessary ensure that they are legal for road use.
- Tyres and wheels can pick up large amounts of mud and snow, which can affect wheel balance significantly. Build ups should be removed prior to driving on-road.

1:3

Windows, mirrors and lights:

Ensure visibility

All windows and mirrors should be clean, completely demisted and de-iced if necessary to allow you to observe as much of the working environment around the vehicle as possible.

- If mirrors are altered for off-road driving (eg: to increase the view of the rear wheels), they should be moved back into a suitable position before returning to the road.
- Lights should be checked prior to driving. Include side lights, head lights, full-beam, indicators and hazard lights, brake lights, reversing and fog lights. Know where all of the controls are for these lights prior to driving a vehicle in adverse conditions.
- Take note of the conditions and anticipate other drivers errors – if visibility is reduced at all (rain, low sun), have dipped beam lights on to help others to spot you.
- Screenwash should be kept topped up, especially in winter conditions when salt spray can seriously degrade visibility if not cleared regularly. Wipers should also be checked regularly.

1:4

Warning lights and status systems:

Check warning lights on ignition

Many 4x4 vehicles rely on the computer systems to function safely. Without these systems, handling may be dangerously compromised. Checking the warning lights on ignition may also help inform you which systems are fitted to an unfamiliar vehicle (ABS, Traction Control, ESP, locking differentials etc), helping you to anticipate and take control of how the vehicle reacts in different situations.

Check status information to ensure the vehicle is set up correctly for the task or hazard ahead, and when terrain changes (snow covered to gritted road, grass to tarmac etc).

1:5

Under the bonnet:

Fluid Levels

Under-bonnet checks should be made on fluid levels as per manufacturers recommendations on a regular basis.

If used off-road, more severe angles can affect levels – ensuring screen-wash, brake fluid, oil, coolant and, where relevant, power steering fluids are well above their minimum.

- *Lack of screenwash can lead to 3 penalty points. Avoid touching fluids without gloves due to the risk of poisoning and dermatitis. If levels are low, diagnose the causes and check regularly.*

1:6

The driver:

Responsibility

The vehicle is the responsibility of the driver, and understanding the vehicle, it's capabilities, limitations and condition is essential for safe driving – especially in adverse conditions.

Any faults found with the vehicle should be reported immediately. Reference should be made to the vehicle manual, and if there is any doubt about the legality or safety of the vehicle, **do not drive it.**

Your final check should be whether you are fit and capable to drive. Make allowances for shorter concentration spans if even slightly ill, and be honest with yourself about your ability and limitations.

Advice, information and training are always available if required. If you feel that you don't fully understand the vehicle you are using, or don't feel confident in your skills in a particular situation – **ask.**

Don't put yourself in a situation that makes you feel nervous.

2:

Equipment, clothing and PPE:

You never know when you'll need it!

2:1

Even with a vehicle in excellent condition, driving off-road, in winter or flood conditions is hard on both vehicles and their drivers. Sometimes, events can overtake you unexpectedly. If you ensure that you have the right clothing and PPE, and an emergency kit, you'll be able to contact help and stay safe and comfortable while waiting for it to arrive.

You are the most important part of the equation. Having the following available, including your work specific equipment, is essential:

2:2

Clothing and footwear suitable for the terrain and for possibly worsening weather conditions outside the vehicle. Hi-Visibility and reflective clothing.

Route checking off-road, through deep snow or floodwater is always necessary, and can be cold, wet and uncomfortable if the correct clothing and footwear is not available. If stranded you may need to walk to obtain a phone signal or to pinpoint your location.

- *Always return to your vehicle, as searchers will always spot this before an individual in adverse weather. In winter, orange hi-vis is more obvious around snow.*

2:3

Food, drink and medication

Some emergency rations should be available if working in adverse weather conditions, or off-road. Those who require medication should ensure that they have quantities to see them through possible extended periods (eg: stranding overnight).

2:4

Mobile phone and charger

Modern mobile phones and their capabilities can be a lifeline in many situations.

Lone workers should check in regularly using company protocols, and communication with colleagues can save time and trouble. Keep contact details updated, including emergency numbers. Ensure that medical information and an In Case of Emergency next of kin number is accessible without a pass-code, or kept on your person at all times.

Dialling 999 or 112 will often get you through to the emergency services even when you have no signal through your normal carrier. In some areas, only 112 will allow emergency services to pinpoint your position. GPS will be able to provide you with a precise grid reference as long as you know how to access this feature.

- *None of these features will be available unless the phone is charged. If you are unable to charge your phone (eg: dead battery), preserve your charge by switching off wifi and bluetooth connectivity. Consider switching off and checking only periodically. Supplementary batteries/chargers could be considered.*

2:5

First Aid Kit

All vehicles should carry one of these, and there should be at least one member of the team who can provide first aid. Lone workers should always have first aid skills in order to keep themselves stable while waiting for assistance. Make yourself familiar with the contents and how to use them.

2:6

Highway code rules 274 & 275.

Warning Triangle

In the event of a vehicle breakdown or stranding on-road, place the warning triangle at least 45 metres away from the vehicle, toward oncoming traffic.

- *Never attempt to place a warning triangle on the motorway*

2:7

Other equipment may be required, depending upon the task, terrain and conditions you are working in. Think through the possible consequences and worst case scenarios and, where practicable, minimise any risks. Items to consider may include:

- Sunglasses – for low sun in winter
- Jump leads – follow the manufacturer's recommendations and, if carried, ensure they can handle increased loads for larger vehicles. Never use to aid third parties
- Shovel – often the simplest tool for recovering a stuck vehicle, but ensure that digging is never undertaken on the low side of a vehicle, or under a vehicle which could move. These can also be useful for depth checking when driving through water, and removing snow from exhaust systems and air intakes if vehicles need to be run when snowed in.
- Torch – with short days, night can be upon you before you know it and can also be used for signalling
- Blanket/sleeping bag/ emergency survival bag – these may make the difference between a comfortable or endurable long wait and severe discomfort or possible problems from prolonged exposure – ensure there are enough for all personnel likely to be in the vehicle.
- Payment card – in the UK, we are rarely too far from civilisation and in changing weather conditions, a decent night's sleep can be bought, ready to tackle another challenging day.

Be prepared, and be equipped, for any situation you can reasonably expect to happen.

3: Check the conditions, your route and stay in contact:

3:1 Knowing what to anticipate will give you every chance to avoid problems. Routes cannot always be changed, but drivers and vehicles with better capabilities for the worst routes can be chosen. Having the information to hand about weather forecasts and site routes will allow you to plan for your own safety. You will often have to adjust your route due to weather, traffic and track conditions, but if you don't let anyone know about these changes, it may well significantly delay the arrival of help if you are stranded.

3:2 Plan your route:

- Check weather, traffic and track conditions for your routes regularly – this will give you invaluable information that can be used for safe and efficient planning.
- Have paper maps available, and check your GPS. Modern satellite navigation systems can provide us with invaluable information but, if they fail, or if working away from recognised roads, maps are essential.
- Know where you are, and be able to direct help to your position accurately.

3:3 Stay in contact:

- File a journey plan where possible and make sure that, if your plans change, you alert colleagues to the changes and your reasons for them.
- Use the lone working system where necessary. These systems are simple to use, but do require the operator to work with them. Obviously many areas can be out of mobile phone signal, but lone working in extreme conditions can have very high risks.
- *Ensuring that you are safe is essential for both your safety and for the organisation. Discuss contact times and durations between. Communication with your line manager is essential and should be based on both the likely risk and sensible pragmatism but, if in doubt, err on the side of caution.*

4: Driving in snow, ice and floods:

4:1 Driving in adverse weather conditions can be extremely dangerous and should only be undertaken by drivers who have the relevant training and information. It relies on individuals understanding how their vehicles will react in different grip conditions and upon them recognising the changes between these conditions. These tips are not intended to replace suitable training and experience, but as a memory refresher at the first notice of an adverse weather event.

4:2 Floodwater and water on tracks:

Floods and standing water can be contaminated, polluted and operators required to work in such areas will need to be aware of depths and rates of flow.

- Check depths. Avoid walking through water, unless equipped and qualified to do so. Be aware of contaminants and debris, depth and the flow of water. On-road, be aware of the possibility of raised manhole covers and fast flowing sewers drawing current and people in – always check with a tool rather than with your feet.
- Do not wade the vehicle beyond the manufacturer's recommendations. Where recommendations are not known or cannot be found, do not take a vehicle deeper than the lowest point of the chassis.
- Do not push a bow wave ahead of you, unless in an emergency situation and you have been trained to do so. The responsibility is with the driver to ensure that it poses no risk to people or property (such as over-topping flood defences, knocking over pedestrians or cyclists, or flooding other vehicles).
- Do not attempt to cross flowing water if there is any doubt about depth or subsurface grip or stability, or if the flow will push against the body of the vehicle (even if within manufacturer's stated wading depths).

4:3 Winter conditions:

In winter conditions, remember that 4x4 systems have their limitations in low grip situations. Larger and higher vehicles are less stable than smaller, lower vehicles. Use their capabilities with caution, but understand the inherent dangers:

- Engage 4 wheel drive systems as soon as you anticipate grip being lost. If your vehicle can be switched from 2 to 4 wheel drive, or has a central differential-lock to engage, find out how to do this while driving and engage prior to problems, to ensure the best control in slippery conditions.
- 4 wheel drive does not improve braking. If your ABS (anti-lock braking system) is activating, then grip is being lost – reduce your speed and use the brakes progressively, well in advance of hazards and bends.
- Disengage 4 wheel drive and differential locks when good grip is regained. Well gritted and clear roads, without ice, will give good grip (ABS should only activate under emergency braking when on surfaces with good grip). In these situations, dis-engaging the 4 wheel drive system, or unlocking the centre differential lock (if these are driver options – many modern 4x4s will do this for you – know how your vehicle works), will reduce the danger of damaging the transmission system. If you don't understand how your 4x4 system works, ask, read the vehicle manual and, if necessary, request training.
- Always ensure that you can stop within the distance that you can see to be clear. If there's a chance that there could be a hazard around the corner, or on the approach to a junction, ensure that you can stop if required. Remember that on narrow roads, where it could be difficult or impossible for vehicles to pass, both you, and the oncoming vehicle, will need to be able to stop in half the distance you can see to be clear.

- Only change speed in a straight line. Braking in a straight line will give you much more control of the vehicle. However, many drivers forget that, in snow and ice conditions, acceleration can lead to loss of grip (wheelspin). In these conditions, having the vehicle in a straight line will allow you to ease off the throttle to reduce wheelspin and will minimise the likelihood of losing steering and positional control of the vehicle.
- Reduce speed prior to hazards, junctions and bends. Braking on bends or while steering is a sure way of ending up in a spin, or a drift, which could put you in danger of collision with other vehicles or static structures off the road.
- Leave acceleration until past hazards, junctions and bends. Accelerating while steering can lead to spins (especially in 2wd mode on rear wheel drive vehicles, such as most pick-ups) or drifting wide (such as in front wheel drive crossover 4x4s before vehicle systems engage 4wd).
- Give other drivers space. Many other drivers on the road will have less experience, less capable vehicles and less training in how to deal with bad weather conditions. Allowing yourself more space will give you more time to react if they lose control of their vehicle. Ice and snow can lead to braking distances 10 times longer than normal.
- Be aware of condition changes, for example:
 - Under and on top of bridges
 - On exposed hillsides
 - In shaded valleys
 - As weather worsens
 - Temperature drops, especially as evening approaches

Driving in winter conditions requires increased planning and anticipation and as such, breaks should be taken more regularly than during normal driving.

5: Transmissions and technology:

5:1 Modern vehicles have a huge range of methods of taking your input (steering, throttle and braking) to where it is needed - at the wheels which have grip!
Understanding the technology, both in terms of physical linkages and in terms of computerised systems based on sensors is essential for drivers to be able to anticipate how their vehicle will react in different situations.

5:2 Mechanical systems:



The methods by which different vehicles transmit the power from the engine to the wheels varies greatly between 4x4s. Ensuring you understand the methods of distribution, including mechanical and electronic couplings, as well as differentials and differential locks, is essential. Study the handbook for any vehicle you are provided with and be aware of how to select the different options, and when it is recommended. Pay particular attention to warnings - improper selection of transmission options can be damaging and unsafe.

5:3

Part-time

4wd:

Part-time, selectable 2-4wd systems will have a user operated lever, dial or switch, marked with the options available. Ensure you know whether your 2wd option is front or rear wheel drive, and how this may effect handling.

- Optional centre differentials are sometimes fitted to selectable 2-4wd vehicles, but usually only on larger or more well specified models. Only use 4wd on high-grip surfaces if you have the option to have the centre differential unlocked.
- *A locked centre differential, or no differential at all will mean that the front and rear axles will be driven at the same speed (wheel speeds across an axle may differ due to axle differentials). On tight turns, this can cause damage to surfaces, tyres and potentially driveline components, as the rear axle will take a shorter line, and will need to get rid of the excess speed. If wheels are 'skipping' on tight turns, consider unlocking centre differentials or de-selecting 4wd until it is required again.*
- *Locking speeds between front and rear axles for long periods can cause tension to build up ('transmission wind-up'), which if released (eg: when vehicle suspension is destabilised), may cause significant unexpected movement of vehicles (understeer, sideways jump) which could be extremely dangerous in busy environments.*

Always unlock differentials and de-select 4wd on flat, high-grip surfaces and normal road conditions.

5:4

Permanent

4wd:

Full-time 4wd systems have a centre differential to allow front and rear axle drive speeds to differ when steering.

- *Centre differentials mean that engine power, and engine braking may only go to one axle. Where grip is required across both axles, centre differential locks should be engaged.*
- *As with part-time 4wd (see above), a locked centre differential, will mean that the front and rear axles will be driven at the same speed (wheel speeds across an axle may differ due to axle differentials). On tight turns, this can cause damage to surfaces, tyres and potentially driveline components, as the rear axle will take a shorter line, and will need to get rid of the excess speed. If wheels are 'skipping' on tight turns, consider unlocking centre differentials or de-selecting 4wd until it is required again.*
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Always unlock differentials on flat, high-grip surfaces and normal road conditions.

5:5

Auto-sensing

4wd:

Auto-sensing 4wd systems rely on wheel speed sensors, computer programming or mechanical devices to engage second axles (in 2-4wd vehicles), as well as potentially engaging locking differentials. Some systems allow some operator input, to select a surface type, which may pre-load transmission elements in preparation for anticipated wheelslip.

- *Sensors, by design, engage systems only once they have detected a problem. Though these systems are improving year by year, many of them still require significant slip before they will engage the systems required to compensate.*

The driver can see what they are approaching, but vehicle sensors can't. Be certain of how systems work, before attempting any hazardous manoeuvres.

5:6

Low range:

Low range gearing is often selectable on larger 4wd vehicles, especially those designed to be driven off-road extensively. Slower speeds can be achieved without slipping the clutch and can give full engine braking at very low speeds. Gearing will reduce speeds for each gear by between 2-3 times (eg: 4th gear high range at 2000 revs = 40mph, in low range this would be between 13-20mph).

- *Low reverse gear will not always be as low as low 1st – test your vehicle in a safe area before needing to use this during an aborted manoeuvre such as a failed hill climb*
- *Sometimes, if stuck on low traction surfaces, low range gears can put too much power down too quickly increasing the likelihood of wheel spin. In the same way as choosing a higher gear is sensible when setting off in snow, high range may be preferable if recovering from boggy areas, especially in reverse.*

Low range gearing will provide you with more control, but not necessarily more grip!

5:7

Electronic systems

Vehicle technology is no longer restricted to cogs and levers, and many systems on vehicles are controlled by computers, which rely on sensors to provide them with information. These systems often cannot be affected by the operator, though some vehicles have simplified some of the changes that operators may wish to make in response to some of the input provided by these sensors.

5:8

ABS:

Anti-Lock Braking systems (ABS) are now a legal requirement on all new vehicles and an essential safety system. When the wheel speed sensors detect that a wheel has locked up, while others have more grip and are being pulled around against the brakes, the system will unlock the wheel which is travelling too slowly.

- *Wheels which are turning can provide much more steering than wheels which are locked.*
- *Wheels which are operating at the limits of their grip on tarmac, will often provide improved braking to wheels which have lost grip and are sliding, reducing overall braking distances.*
- *If ABS has engaged, it suggests that the driver may have mis-judged the grip available for braking, or not anticipated a problem. As professional drivers we should try to avoid the use of this system wherever possible.*
- *On some surfaces, such as in deep snow or other heavily deformable terrain (sand, deep gravel), braking distances may be increased.*
- *At some point, ABS must switch off to enable a vehicle to come to a stop, and stabilise, especially on hills. Some ABS systems will operate to extremely low speeds, which is useful when on very low traction surfaces such as ice or wet grass, other systems will allow all wheels to lock at speeds approaching 7mph. Losing all directional and braking control of a vehicle at 7mph could prove catastrophic if near edges leading to water, or around other road users. Know how well your system works.*
- *On very low traction surfaces, steering capability will be so reduced that even with ABS, vehicle direction may not be controllable.*



The 4x4 system will NOT improve a vehicle's braking or steering ability – often commercial 4wd vehicles are heavier and have lower specification safety and braking systems than standard cars – adjust your driving style accordingly!

5:9

Traction Control:



Traction control systems use the same wheel speed sensors as the ABS system. They detect when a wheel is travelling much faster than the others, and use the braking system to reduce its speed to keep it in line with the others. This can be used to force power across axle differentials from one wheel (eg: the wheel spinning on the grass verge), to the other wheel (which has good grip on tarmac).

- Traction control will engage at varying points, and will apply the brakes in different ways on different vehicles and in different settings.
- Usually, holding the throttle steady and allowing the system to compensate will begin to move the vehicle forward if at least one wheel (on a powered axle) has enough grip.
- *When grip is limited to the point that traction control is necessary, vehicles can slide sideways – only try to increase speed with the steering wheels straight.*
- *Sometimes, systems can apply brakes and reduce engine power quite dramatically, especially when going up slippery hills – always be prepared to reverse back down if you lose too much momentum.*
- *If traction control can be switched off, know how and when this should be done by referring to the vehicle manual, and switch it back on at the earliest opportunity when grip has been regained.*

Traction control can help large heavy vehicles gain speed, momentum and kinetic force even in very low grip situations – remember that if traction control has been used to get you up to speed, you may well need the emergency systems to help you reduce it and steer. Keep the speed down until good grip is regained.

5:10

ESC/ESP:



Electronic Stability Control/Electronic Stability Programmes have a wide variety of names, depending upon the manufacturer's preference (DSC/ASC etc). The systems detect sideways movement, by comparing the direction the steering wheel is pointing with the information being received by the sensors. The system can detect understeer (vehicle pushes straight instead of turning), and oversteer (rear of vehicle loses grip and slides wide, leading to a spin). Some systems can also detect sideways slide.

- In order to counteract unwanted movement, the system may take control of individual wheel brakes, engine power, and in the case of some 4wd systems, the differentials, throttle response and suspension adjustments.
- *ESC can cause loss of power and unwanted braking effects on slippery surfaces. These effects should be taken account of when planning routes through hazards.*

ESC is an essential safety feature and in a workplace environment must only be switched off when absolutely necessary, and in accordance with manufacturers' recommendations.

5:11

Special Programmes:

Many modern vehicles are being designed to fulfil customers requirements for capability throughout the year, coping with adverse weather and differing terrains. Modes for snow and ice, mud, sand and descending hills are becoming common. These systems may affect the throttle response (not allowing so much power to the wheels when setting off for example), ABS response, ESC reaction and in some circumstances they may be able to affect mechanical units such as differentials and couplings. Learning as much as possible about your vehicle is essential, which is why the Provision and Use of Work Equipment Regulations specifies that operators must have access to equipment manuals at all times.

5:12

Suspension:

Suspension systems differ dramatically between vehicles, with many load carrying 4x4s having beam axles, often with leaf-springs, whereas others will have coil sprung independent suspension.

- **Leaf springs** often provide excellent load carrying capability, *but may restrict axle articulation (up/down) and increase the chance of individual wheels losing grip as the pressure pushing the tyre down onto the driving surface is reduced.*
- **Coil springs** tend to provide more articulation, *but can be crushed more easily over bumps, leading to clearance issues off-road.*
- **Beam axles** tend to improve clearance off-road, *but will sometimes lead to reduced handling at speed in comparison with independent suspension.*

Some vehicles have air suspension, which allows the operator to increase clearance for off-road use. These systems allow vehicles to sit lower at higher speeds, improving road holding, than many traditional off-road capable 4x4s.

Some load carrying 4x4s have airbags which can be inflated to keep vehicles level when heavily loaded, though these systems may affect road holding and articulation and grip off-road.

Understanding what kind of suspension is fitted to your vehicle is essential – check new vehicles over and read the owner’s manual.

6: Driving Off Road

6:1

Once we take vehicles off tarmac, we have to increase our level of observation and decision making processes really do need to be complete prior to hazards. To enable us to drive to a high professional standard, lower speeds are required in the vast majority of situations.

Though the risks to the health and safety of personnel and third parties may be reduced at these lower speeds, operational costs such as lost time, vehicle damage and maintenance can rise dramatically when vehicles are taken off road, especially when operators are inexperienced or have a limited understanding of their vehicles capabilities and limitations.

6:2

Grip – to get you moving, for steering and stopping.

Grip is essential in order to get or keep a vehicle moving, in order to steer, and in order to hold or reduce speed either through engine braking or with the wheel brakes.

Recce:

- Surface grip levels should be checked on foot whenever drivers are unsure – **if you can’t walk it, don’t attempt to drive it!**

Grass:

- Grass can be deceptive – providing good grip when dry, but similar to ice when wet.
 - *The difference between frosty grass in the shade and wet grass where the sun has reached it can be dramatic – if unsure, check the grip on foot.*

Mud:

- Vehicles can easily bog down in muddy areas without a hard sub-surface.
 - *Experienced drivers may understand the correct techniques for driving through muddy areas, but mistakes are easy to make – always plan for the worst and be prepared.*

Ruts:

- Ruts can help to show where vehicles have been before, suggesting possible routes, and when working on private land, these should be followed wherever possible.
 - *Ruts can be made by a variety of machines, and a standard 4x4 may not be able to follow tracks made by a tractor or a quad bike for example.*
 - *Clearance can become an issue, with raised central areas. Sometimes it may be necessary to straddle ruts, but be aware of the danger of sliding back into them, and be prepared to turn back if straddling them would make tracks wider or otherwise cause damage to land.*
 - *Once in ruts, steering ability can be compromised – be prepared to reverse out, rather than steer out.*
 - *Check wheel position – if the vehicle feels as though it is constantly slipping sideways, the wheels may well be attempting to climb out of the ruts. As long as the track is safe to follow, take a lighter grip on the wheel and take notice of the feedback from the wheel, without allowing it to swing wildly. Wheels will always try to sit in the deepest point – as long as you have clearance, this is often where the best grip is.*

Tree roots:

- Tree roots can be extremely slippery, pushing or pulling vehicles into danger.
 - *Try to avoid damaging tree roots – exposing them and driving over them can compromise the health of trees.*

Sand:

- Sand grip can vary immensely, depending upon the make up of the sand itself, its moisture content and its compaction.
 - *Always check sand on foot prior to driving – look for colour and surface texture changes when driving.*
 - *Avoid working between tide lines wherever possible, as surfaces can be unpredictable and the risk if stuck is increased. If required, you should have a specific risk assessment and safe working protocols in place for working on beaches.*

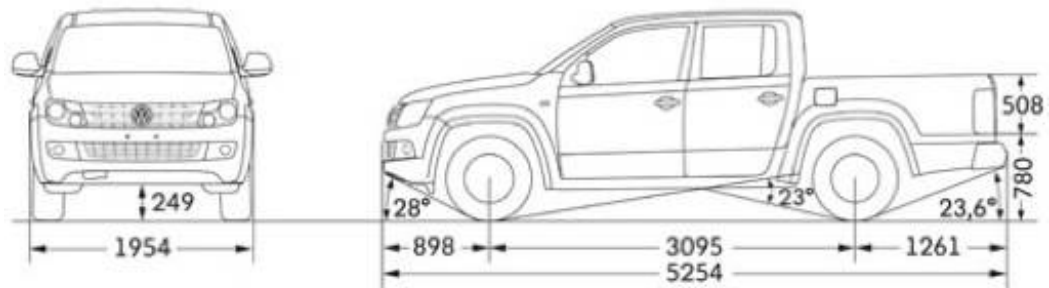
Cross-axle:

- Cross-axes occur in areas where suspension articulation is pushed to its limits, increasing the weight on one wheel on each axle, and reducing the weight (or lifting off the ground entirely) on the other. In an area where there is a wheel on each axle with little or no weight pushing down to get grip, vehicles without locking axle differentials will slip, unless electronic traction aids can overcome the problem (traction control or, if descending, hill-descent control systems).



Clearance – approach, breakover, departure and axles

Clearance is an important consideration when driving off-road, not only from a vehicle damage perspective, but also in order to keep moving.



Grounding a vehicle on a ridge for example could lead to lost time for the personnel involved, costs of specialist vehicle recovery and hire costs for a replacement vehicle while yours is being repaired. Understanding your clearance limitations can reduce these costs and your embarrassment in making the dreaded phone call!

Approach:

- **The Approach Angle** is the angle at the front of the vehicle, which can sometimes be reduced by winches, but is often much better than the departure angle at the rear of the vehicle – bear in mind that these two angles need to be taken into account together – if you want the front of the vehicle to climb over something, the rear is going to dip down and may catch.

Departure:

- **The Departure Angle** at the rear of the vehicle is often severely compromised by fixed towing hitches. Catching tow-bars can ‘anchor’ the vehicle, stopping it from making progress. If severely dug in, this can then stop the vehicle from being able to reverse out of a situation. Damage can easily be done to trailer electric sockets, so any contact at the rear when off-road should be thoroughly checked.

Breakover:

- **The Breakover Angle** is the angle between the front and rear axles and the underside of the centre of the vehicle. When trying to drive over ridges, vehicles with longer wheelbases, or lower bodies will ground out earlier.

Under-axle:

- **Underbody or axle clearance** depends upon the lowest point of the vehicle, and needs to be understood when driving over objects, or when following ruts. Grounding in ruts can damage steering and suspension components, differentials and cause vehicles to lose momentum and become stuck.

If your vehicle contacts the ground – check for damage and re-assess your route.

6:4

Exit strategies

There are times when plan A fails, either through a loss of grip, or from grounding out, at this point there always needs to be an exit strategy.

When risk assessing routes, planning the exit strategy should take the same priority as the intended route. Look for safe run out areas where grip can be regained, and alternative routes which could be used if clearance disappears.

Base exit strategies on the line of least resistance, which will often be downhill. Wheels should be powered wherever possible, by choosing a gear and leaving the clutch up, or changing gear and engaging it by bringing the clutch back up so the vehicle is actively driving – giving you the best chance to get grip for steering and engine braking.

- Failed hill-climbs occur when grip is lost, or engines stall. The exit strategy should be to reverse out of the situation, with the gear engaged.
- During side slides, especially on slopes, drivers should always steer in the direction of the slide rather than fight against it – this will usually be DOWN!

If in doubt about the safety of your exit strategy – avoid it!

7:

Responsibility

7:1

At all times, the responsibility for the safety of the vehicle and, to a great extent, the safety of the personnel and equipment being carried in it, lies with the driver.

7:2

Under the Road Traffic and Safety Acts, there is an obligation on the driver to ensure that the vehicle is safe and legal to be driven on the road. This can include, but is not limited to:

- The vehicle is in a safe and roadworthy condition.
- The vehicle is taxed, and where necessary has an MOT.
- The driver is licensed to drive the vehicle and adheres to license stipulations.
- The driver is insured to drive the vehicle at all times
- The driver is fit to drive and not suffering from the effects of:
 - Any illness which may seriously impair driving ability
 - Drink, drugs or other impeding medication

7:3

Under the Health and Safety at Work Act, and it's regulations, the driver must:

- Ensure that the vehicle is suitable for the anticipated task
- Check that the vehicle is in a safe condition
- Understand all of the controls of the vehicle
- Have received appropriate training
- Use the appropriate PPE provided during all tasks
- Operate the vehicle in accordance with the manufacturers' recommendations

7:4

Your company will also have driving and equipment policies, which must be adhered to, along with any safety, lone working and communication policies. You are responsible for your own safety, for the safety of the people you are working with, and for minimising any risk to third parties and the public in general.

4x4 and All Wheel Drive vehicles are an extremely useful tool in the correct hands. Use their abilities cautiously and be aware at all times of their limitations.

Review 05/17

Compiled by Tim Manwaring, senior trainer. 12/05/16.